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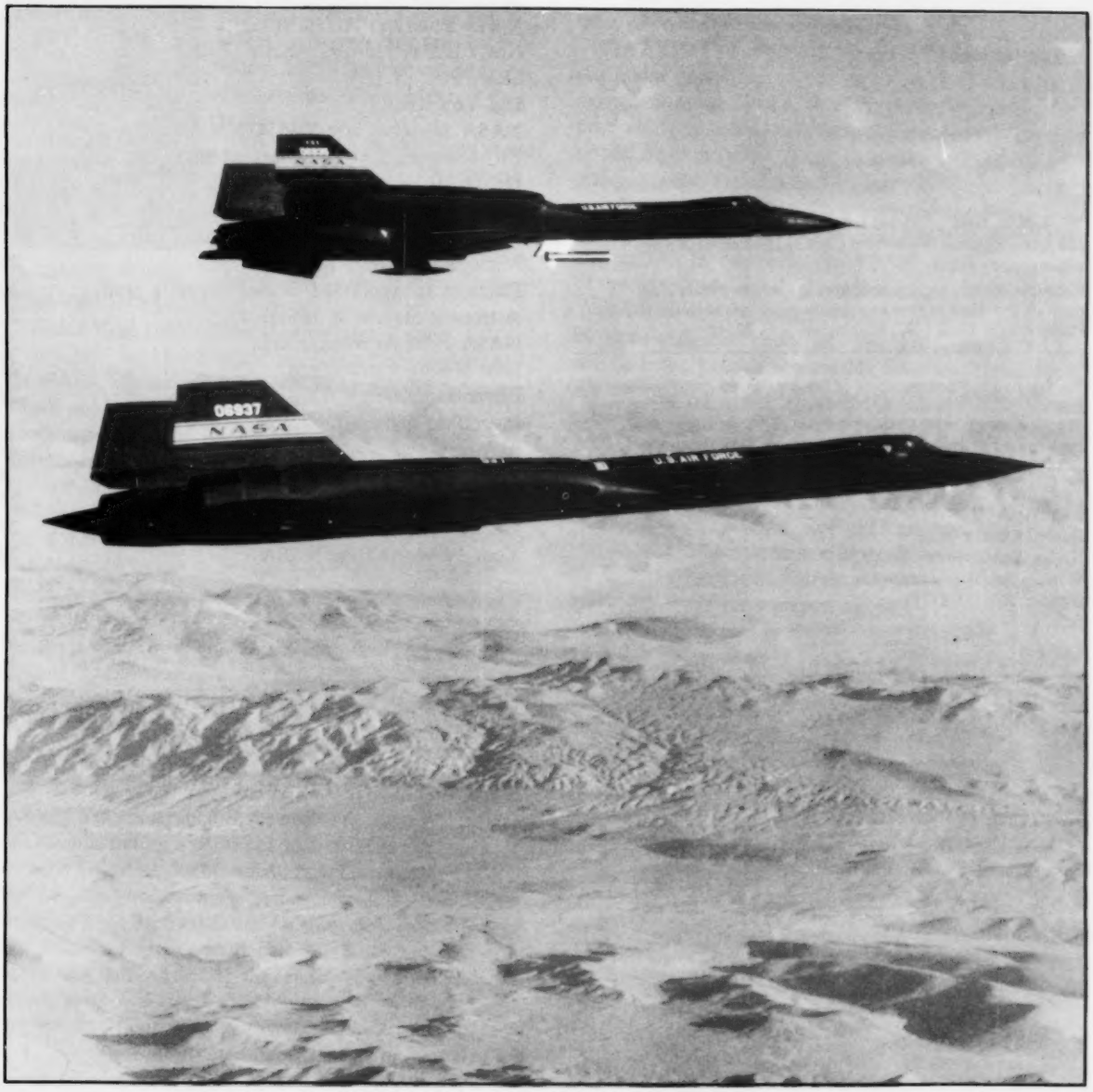

COVER

The Dryden Flight Research Center's two YF–12 aircraft flew together for the first tme in the fall of 1975. The test fixture suspended under the 935 (upper craft) is used to study the effects of extremely rapid build-ups of temperature at speeds of more than 2,000 miles per hour. The temperature of the fixture is kept below zero degrees until testing is ready to begin. Explosives mixed with chemicals within the insulator then are activated to blow off the cover. Gauges inside the mechanism measure rate of heat, which rapidly climbs to levels exceeding 150 C. (300 F.).

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Ann Weeks,
Editor, Code FGC,
NASA Headquarters, F.O.B. NO. 6,
Washington, D.C. 20546
(Phone: 202-755-8479).

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Letter from Washington

Dear Colleagues:

The FY 1977 budget for NASA, although remaining lean, is a healthy one. Overall, it will enable us to continue progress toward an era of widespread participation in the exploration and use of space and of more efficient flight in the atmosphere.

Dr. James C. Fletcher

In his State of the Union message, President Ford urged seeking a balance that favors a sound, active government and a more vigorous, healthier economy.

We at NASA can be justly proud of our role in helping to establish such a balance by our increasing productivity and accomplishments in the face of continuing decreases in constant budget dollars. Few other Federal agencies can match our record.

Fiscal Year 1977 will be another year of tight constraints, minimal budgets and limited new activities for NASA. Some important activities will be deferred. There will be, for instance, a one-year delay in construction start on the third Shuttle Orbiter; and postponement for consideration next year of starting the Space Telescope, a "Pioneer" type orbiter and probe of Jupiter (PJOP), and the modification and repowering of the wind tunnel at our Ames Research Center.

In contrast to last year's budget of no new program starts, however, this fiscal year will see some limited but vital "next step" activities. Although our FY 1977 budget is lean, it will enable us to continue progress toward the era of widespread participation in the exploration and use of space and of more efficient flight in the atmosphere.

Some of these "next step" activities are:

- *A Solar Maximum Mission* (SMM)—A spacecraft to study Sun spots, solar flares and other solar phenomena during a period of peak solar activity in 1979-1980. With SMM, scientists will be able to build on the breakthroughs in the study of the Sun resulting from the Skylab and Orbiting Solar Observatory missions and to gain a more complete understanding of the mechanisms driving the release of solar energy which, in turn, has such a profound effect on life, weather and climate here on Earth.
- *Magsat*—A third applications explorer satellite to provide data for mapping the Earth's magnetic field. This information is expected to be useful in the exploration for natural resources such as oil and minerals.
- The *Thematic Mapper*—Development of a new instrument to increase our future capability in detecting and monitoring Earth resources from space.
- The *National Transonic Facility*—A specialized aeronautical research facility to be located at the Langley Research Center. This urgently needed facility, which has been studied and supported by both NASA and DOD over the last several years, will provide advanced capabilities to measure air-flow characteristics of aircraft operation near the speed of sound and will have wide applications as an R&D tool for development of future civilian and military aircraft.

The FY 1977 budget will permit us to proceed with our major ongoing programs as planned. Except for the deferment of the third orbiter, the Space Shuttle is proceeding on schedule with an objective of first manned orbital flight in 1979. We will continue to move ahead on science and application missions.

It is worth noting that our launch activity during this calendar year will involve more flights sponsored and paid for by others than by NASA. Only two of the 16 to 19 launches planned will be entirely NASA funded missions. Another two are NASA cooperative missions with other countries. The remaining 12 to 15 will be entirely funded by outside interests. Thus, we are entering a period of widespread use of space by other agencies of Federal government, as well as by private industry and foreign governments.

We plan to focus substantial efforts on the development of technology that will permit the United States to maintain its role as innovator and leader of the world's aeronautics industry. Such efforts will be aimed at the U.S. production of aircraft with twice the energy efficiency of current transport aircraft.

In the field of energy research and technology, we will continue to make NASA's considerable expertise and capabilities available to ERDA and other agenices on a reimbursable basis.

I am confident that the programs provided for in the FY 1977 budget will serve as a measure of progress in achieving the nation's objectives in space and aeronautics and signify our resolve to remain fully committed to that goal.

Sincerely,

James C. Fletcher
Administrator

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

BUDGET SUMMARY
(Thousands of Dollars)

BUDGET PLAN	FY 1975	FY 1976	Transition Quarter	FY 1977
Research and development	2,323,563	2,677,380	700,600	2,758,925
Construction of facilities	142,655	82,130	10,750	124,020
Research and program management	764,704	795,498[a]	220,795[a]	814,055
TOTAL BUDGET PLAN	3,230,922	3,555,008	932,145	3,697,000
OUTLAYS	3,266,708	3,517,200	908,700	3,676,000

a/ Includes proposed supplemental to cover increased salary rates effective October 1975:

FY 1976	$19,986,000
Transition Quarter	7,117,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND DEVELOPMENT PROGRAMS

BUDGET PLAN
(Thousands of Dollars)

	FY 1975	FY 1976	Transition Quarter	FY 1977
SPACE FLIGHT	1,235,800	1,560,500	406,500	1,644,700
Space shuttle	797,500	1,206,000	321,000	1,288,100
Space flight operations	298,800	188,600	48,400	205,200
Expendable launch vehicles	139,500	165,900	37,100	151,400
SPACE SCIENCE	417,315	434,200	116,400	379,025
Physics and astronomy	136,315	159,300	43,500	165,800
Lunar and planetary exploration	261,200	254,100	67,700	191,100
Life sciences	19,800	20,800	5,200	22,125
APPLICATIONS	174,748	178,230	47,700	198,200
Space applications	174,748	178,230	47,700	198,200
AERONAUTICS AND SPACE TECHNOLOGY	237,765	250,250	63,100	271,100
Aeronautical research and technology	166,400	175,350	43,800	189,100
Space research and technology	71,365	74,900	19,300	82,000
ENERGY PROGRAMS	4,435	5,900	1,500	---
Energy technology applications	4,435	5,900	1,500	---
TRACKING AND DATA ACQUISITION	248,000	240,800	63,400	258,000
TECHNOLOGY UTILIZATION	5,500	7,500	2,000	7,900
TOTAL	2,323,563	2,677,380	700,600	2,758,925

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND PROGRAM MANAGEMENT

TOTAL NUMBER OF PERMANENT POSITIONS

END OF YEAR

INSTALLATION	FY 1975	FY 1976	FY 1977
Johnson Space Center	3,632	3,613	3,613
John F. Kennedy Space Center, NASA	2,259	2,259	2,259
Marshall Space Flight Center	4,113	4,113	3,925
National Space Technology Laboratories	70	70	70
Goddard Space Flight Center	3,753	3,747	3,675
Wallops Flight Center	416	415	414
Ames Research Center	1,678	1,676	1,613
Flight Research Center	490	497	497
Langley Research Center	3,309	3,330	3,172
Lewis Research Center	3,025	3,025	3,025
NASA Headquarters	1,571	1,571	1,553
TOTAL	24,316	24,316	23,816

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE FLIGHT

BUDGET PLAN
(Thousands of Dollars)

	FY 1975 Actual	FY 1976	Transition Quarter	FY 1977
SPACE SHUTTLE	797,500	1,206,000	321,000	1,288,100
Orbiter	634,757	871,200	226,000	842,500
Main engine	95,300	135,500	36,000	193,800
Solid rocket boosters	21,143	69,300	18,000	82,600
External tanks	34,000	77,200	17,100	64,000
Launch and landing	12,300	52,800	23,900	105,200
SPACE FLIGHT OPERATIONS	298,800	188,600	48,400	205,200
Development, test and mission operations	170,200	161,100	41,100	169,900
Space transportation system operations capability development	3,000	9,500	2,000	17,300
Apollo Soyuz test project	109,600	---	---	---
Advanced programs	16,000	18,000	5,300	18,000
EXPENDABLE LAUNCH VEHICLES	139,500	165,900	37,100	151,400
Scout	12,300	10,600	3,400	10,700
Centaur	75,400	110,100	24,400	90,700
Delta	51,800	41,800	9,300	43,800
Atlas F	---	3,400	---	6,200
TOTAL SPACE FLIGHT	1,235,800	1,560,500	406,500	1,644,700

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SCIENCE

BUDGET PLAN
(Thousands of Dollars)

	FY 1975	FY 1976	Transition Quarter	FY 1977
PHYSICS AND ASTRONOMY	136,315	159,300	43,500	165,800
High energy astronomy observatories	42,900	59,218	13,500	36,600
Solar maximum mission	---	---	---	21,300
Solar maximum mission - advanced technological development	1,515	1,000	700	---
Orbiting explorers	33,945	29,682	7,400	33,000
Solar observatories	4,305	3,600	900	1,000
Astronomical observatories	2,216	2,500	600	2,600
Sounding rockets	19,976	20,000	6,200	20,700
Spacelab science program	3,330	4,600	3,500	10,000
Upper atmospheric research	---	3,500	1,000	11,600
Airborne/Balloon programs	4,858	4,800	1,300	5,300
Supporting research and technology	13,870	14,400	3,600	14,700
Data analysis	5,000	5,000	1,300	5,000
Skylab data analysis	1,400	6,000	1,500	4,000
Space telescope - advanced technological development	3,000	5,000	2,000	---
LUNAR AND PLANETARY EXPLORATION	261,200	254,100	67,700	191,100
Viking	89,016	39,500	11,600	24,200
Outer planets missions	69,761	82,400	22,100	50,300
Pioneer/Helios	33,642	61,700	16,400	47,400
Mariner-Venus/Mercury	5,324	---	---	---
Supporting research and technology/ advanced studies	11,000	11,000	2,500	11,600
Planetary data analysis	1,628	1,400	400	2,500
Planetary astronomy	4,200	4,200	900	4,800
Planetary flight support	24,725	29,200	8,700	27,900
Lunar research program	21,904	24,700	5,100	22,400
LIFE SCIENCES	19,800	20,800	5,200	22,125
Space life sciences	15,000	16,000	4,300	17,325
Planetary biology	3,300	3,300	600	3,300
Planetary quarantine	1,500	1,500	300	1,500
TOTAL, SPACE SCIENCE	417,315	434,200	116,400	379,025

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE APPLICATIONS

BUDGET PLAN
(Thousands of Dollars)

	FY 1975	FY 1976	Transition Quarter	FY 1977
EARTH RESOURCES DETECTION AND MONITORING	58,687	59,730	13,900	67,300
LANDSAT - 1 & 2	8,700	5,300	---	---
LANDSAT-C	9,000	13,000	3,500	13,500
Applications transfer and demonstration program	8,778	9,300	2,500	14,800
Applications research and technology development and related activities	32,209	32,130	7,900	35,000
Thematic Mapper	---	---	---	4,000
EARTH DYNAMICS MONITORING AND FORECASTING	9,600	8,000	2,200	4,600
LAGEOS	1,300	1,000	300	---
Tectonic plate motion	1,900	2,600	700	1,900
Applications research and technology development and related activities	6,400	4,400	1,200	2,700
OCEAN CONDITION MONITORING AND FORECASTING	15,600	20,800	6,500	30,600
SEASAT-A	8,000	15,000	5,000	25,300
Applications research and technology development and related activities	7,600	5,800	1,500	5,300
ENVIRONMENTAL QUALITY MONITORING	36,400	22,200	9,400	26,100
NIMBUS-G	19,000	13,000	6,700	15,400
Applications research and technology development and related activities	7,400	9,200	2,700	10,700
WEATHER AND CLIMATE OBSERVATION AND FORECASTING	42,073	42,700	9,600	36,300
NIMBUS - 5 & 6	9,300	5,700	---	---
TIROS-N	7,300	8,200	2,100	8,600
CARP	7,200	7,000	2,000	6,000
SMS - 1 & 2	2,100	---	---	---
Severe storm research program	6,973	8,800	2,100	7,100
Applications research and technology development and related activities	9,000	13,000	3,400	14,600
MATERIALS PROCESSING IN SPACE	4,600	5,700	1,200	9,200
SPACE COMMUNICATIONS	12,000	10,000	1,900	18,600
INFORMATION MANAGEMENT	3,200	3,200	800	3,200
APPLICATIONS EXPLORER MISSIONS	2,588	5,900	2,200	10,300
TOTAL, SPACE APPLICATIONS	174,748	178,230	47,700	198,200

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

AERONAUTICS AND SPACE TECHNOLOGY

BUDGET PLAN
(Thousands of Dollars)

	FY 1975	FY 1976	Transition Quarter	FY 1977
AERONAUTICAL RESEARCH & TECHNOLOGY	166,400	175,350	43,800	189,100
Research and technology base	83,472	85,425	21,400	89,700
Systems studies	2,884	3,096	700	3,000
Systems technology programs	31,022	43,170	12,300	60,800
Experimental programs	49,022	43,659	9,400	35,600
SPACE RESEARCH AND TECHNOLOGY	71,365	74,900	19,300	82,000
Research and technology base	61,090	61,075	15,700	62,100
Systems studies	1,600	1,825	400	1,600
Systems technology programs	1,675	2,200	600	3,100
Experimental programs	2,000	3,700	1,100	6,900
Low cost systems program	5,000	6,100	1,500	8,300
TOTAL AERONAUTICS AND SPACE TECHNOLOGY	237,765	250,250	63,100	271,100

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

OTHER BUDGET ACTIVITIES

BUDGET PLAN
(Thousands of Dollars)

	FY 1975	FY 1976	Transition Quarter	FY 1977
ENERGY PROGRAMS				
ENERGY TECHNOLOGY APPLICATIONS	4,435	5,900	1,500	---
TRACKING AND DATA ACQUISITION				
TRACKING AND DATA ACQUISITION	248,000	240,800	63,400	258,000
Operations	192,600	193,500	50,100	206,800
Systems implementation	42,500	38,100	11,000	42,500
Advanced systems	9,300	9,200	2,300	8,700
Tracking and data relay satellite system	3,600	---	---	---
TECHNOLOGY UTILIZATION				
TECHNOLOGY UTILIZATION	5,500	7,500	2,000	7,900

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1977 CONSTRUCTION OF FACILITIES PROGRAM

BUDGET PLAN
(In thousands of Dollars)

PROJECTS BY INSTALLATION	FY 1977
Ames Research Center	4,490
Modification for high enthalpy entry facility	1,220
Modification of flight simulator for advanced aircraft	1,730
Construction of supply support facility	1,540
Flight Research Center	750
Construction of addition to flight control facility	750
Johnson Space Center	2,800
Construction of addition to lunar sample curatorial facility	2,800
Kennedy Space Center	2,805
Construction of airlock to spin test facility	360
Modifications for utility control system	2,445
Langley Research Center	6,185
Construction for addition for aeroelastic model laboratory	730
Construction of data reduction center annex	2,970
Construction of refuse-fired steam generating facility	2,485
Lewis Research Center	2,170
Modification of refrigeration system, electric propulsion laboratory	680
Rehabilitation of combustion air drying system, engine research building	1,490
Large Aeronautical Facility	25,000
Construction of national transonic facility (LaRC)	25,000
Space Shuttle Facilities at Various Locations as Follows:	39,825
Construction of orbiter processing facility (KSC)	3,750
Modifications to launch complex 39 (KSC)	19,855
Modifications for solid rocket booster processing facilities (KSC)	9,700
Construction of shuttle/carrier aircraft mating facility (KSC)	2,050
Modifications for crew training facilities (JSC)	780
Rehabilitation and modification of shuttle facilities, at various locations	1,760
Modification of manufacturing and final assembly facilities for external tanks, (MAF)	1,930

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1977 CONSTRUCTION OF FACILITIES PROGRAM

BUDGET PLAN
(In thousands of Dollars)

PROJECTS BY INSTALLATION	FY 1977
Space Shuttle Payload Facilities at Various Locations as Follows:	4,340
Modifications to operations and checkout building for spacelab (KSC)	3,570
Modifications and addition for shuttle payload development (GSFC)	770
Rehabilitation and Modification of Facilities at Various Locations, Not in Excess of $500,000 Per Project	17,875
Minor Construction of New Facilities and Additions to Existing Facilities at Various Locations, Not in Excess of $250,000 Per Project	5,125
Facility Planning and Design	12,655
TOTAL PLAN	124,020

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND PROGRAM MANAGEMENT

BUDGET PLAN
(Thousands of Dollars)

INSTALLATION	FY 1975	FY 1976	Transition Quarter	FY 1977
Johnson Space Center	121,332	128,189	36,139	134,254
John F. Kennedy Space Center, NASA	95,918	97,411	30,469	103,624
Marshall Space Flight Center	129,050	133,442	35,662	133,165
National Space Technology Laboratories	1,623	1,767	442	1,833
Goddard Space Flight Center	104,767	108,591	28,837	109,178
Wallops Flight Center	12,376	13,054	3,638	13,654
Ames Research Center	48,571	50,561	13,188	50,518
Flight Research Center	13,246	14,097	5,048	15,832
Langley Research Center	88,642	92,922	24,319	91,691
Lewis Research Center	80,314	81,711	22,574	85,739
NASA Headquarters	68,865	73,753	20,479	74,569
TOTAL	764,704	795,498 a/	220,795 a/	814,055

a/ Includes proposed supplemental to cover increased salary rates effective October 1975:

FY 1976	$19,986,000
Transition Quarter	7,117,000

NASA Officials Assess New Budget

Fletcher says new space request is four percent above previous year, but still "not all it ought to be."

The NASA budget for Fiscal Year 1977 was described and discussed at a press briefing by NASA Administrator Dr. James C. Fletcher in mid-January. Deputy Administrator Dr. George M. Low and NASA Comptroller Wililam E. Lilly explained various aspects of the NASA request, and all three answered questions asked by members of the large audience, after prepared statements had been read.

Dr. Fletcher told the assemblage that NASA's FY 1977 budget estimates called for authorization and appropriations of $3.697 billion and net outlays of $3.676 billion. He said that NASA planners had "hoped and fully expected to present a much more aggressive space and aeronautics program for 1977—a program that would have provided for a more adequate level of advanced research and technology for the future . . . [but] our plans and expectations, along with those of many other agencies were, of course, overtaken by the Government-wide necessity for additional fiscal restraints."

The Administrator added that: "We have had to squeeze ongoing space and aeronautics and defer some important work." The major deferrals, he said, include a year's delay in starting production of the third Shuttle orbiter; and a delay in the creation of the Space Telescope, a new orbiter and probe of Jupiter, and work on the wind tunnel at the Ames Research Center.

Dr. Low used slides to illustrate his remarks, which dealt with NASA's budget outlays and trends, personnel, and future missions. He said that, in view of the inflation of recent years, the NASA budget probably should be about a billion dollars more than it is. He said: "You can put this in the context of where we were at the peak of Apollo . . . translating it into 1977 dollars, we really have tightened our belt, from $11.4 billion down to the $3.6, with the effect that we are doing much less than we had planned to do, but I think we are also considerably more efficient than we were at that time. We are getting more space for the dollars."

He added that at the peak of Apollo, NASA's share of the Federal budget was 4.4 percent, but that today the agency receives less than one percent.

Dr. Fletcher said that the 1977 budget will, however, permit NASA to proceed on plan with most of the ongoing space and aeronautics programs, and that the budget does contain some limited but vital "next step" activities. He spoke of NASA's expectations of 18 to 23 launches in 1977 and said that only six will be missions primarily funded by NASA, including the two Mariner missions to Jupiter and Saturn, the first

High Energy Astronomical Observatory, Landsat–C and two others. He mentioned that even the NASA-funded missons will involve significant scientific and financial participation by European governments.

Dr. Low stated that the NASA work force has diminished year by year from a peak of almost 80,000 during the Apollo years, and that FY 1977 decreases will bring that figure to 45,751, about half in support contractors and half in civil service. He said that the decrease in Civil Service personnel, 1976 to 1977, will be about 500.

He spoke of the importance of aeronautics and aviation to the national economy and the need for the U.S. to maintain its share of the market. He said: "How do we maintain this? Only by having better airplanes, more productive airplanes, only by having the best available technology. So, the punch line here is that new technology is needed to capture the next generation of aircraft sales."

Mr. Lilly, in discussing work force decreases, said: "Reductions will come primarily from the Institutional Assessments, Roles and Mission Studies that have been going on for the past year. There is a reduction at Marshall of about 188; Goddard has about 70 reductions; Langley a little over 150, and those are the major changes . . . slight other changes, about 19 at headquarters."

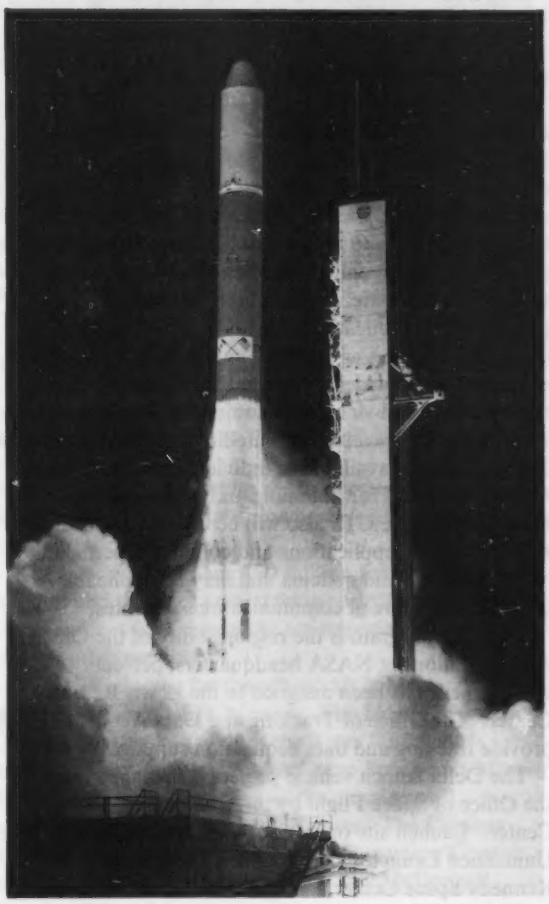
Responding to a question about total personnel, Mr. Lilly said that in 1976 NASA had 24,316 civil servants compared to 23,816 in FY 1977; support contractors amounted to 17,514 in 1976; 16,847 in FY 1977. Total reductions, he said, are about 1,600, or 47,373 in FY 1976 compared to 45,751 in 1977.

In his concluding remarks, Dr. Fletcher said: "Although this is to be one more year of holding the line, I sincerely believe that we will be able to continue to achieve significant accomplishments . . . I continue to believe that an adequate continuing investment in the future—namely, in research and technology—is the key to increasing national productivity, efficiency and well being. Continual squeezing of essential research and technology efforts, either directly by underfunding or indirectly by inflation, is bound to undercut the viability of the entire program and foreclose important opportunities for the nation's future."

Monthly NASA Highlights

Most Powerful Communications Satellite Launched

The Communications Technology Satellite (CTS) was launched successfully by a Delta launch vehicle on Jan. 17 from Cape Canaveral. The Delta launch vehicle performance was nominal and placed the spacecraft in the desired transfer orbit. The apogee



Canadian-United States Spacecraft Launched—Communications Technology Satellite, the most powerful communications satellite ever placed in space, was launched in mid-January aboard Delta 119. The 1,485-pound spacecraft was placed in synchronous or hovering orbit 22,300 miles above the equator at 116 degrees west longitude over South America. CTS represents a five-year cooperative effort by Canada and the United States. It will be used in an experimental program to pioneer new communication services.

motor was fired on Jan. 20, initiating the drift orbit phase. CTS is expected to be on station at an altitude of about 36,000 kilometers (22,300 miles) at 116 degrees west longitude, above South America.

The CTS is a cooperative effort between NASA and Canada's Department of Communications. The experimental satellite will extend communications technology to much higher power levels of transmission than had been previously used. The new technology incorporated in CTS will make possible high-quality color television reception and two-way voice communications with the use of small, low-cost user-operated ground terminals.

Communications experiments are planned by a variety of users in the U.S., including government, educational and industry groups. A consortium of European nations, through the European Space Agency, is also participating, in association with the Canadian government.

Community services such as education, health care, data communications and public broadcasting will be provided to segments of world populations that cannot be reached by either terrestrial or existing satellite communications systems. Health-care agencies will be linked via CTS to disseminate information between research institutes and the medical community, and to evaluate teleconferencing among health care professionals. Educational institutions will participate in teacher training and shared curriculums. Industrial organizations in widely separated locations will determine if audio and video communications can be substituted for travel. The Satellite Library Information Network will be available to individuals and organizational groups for obtaining and disseminating information. The CTS also will be used to demonstrate new technology applications and conduct experiments on components and systems that may be applicable to future commercial communications satellites.

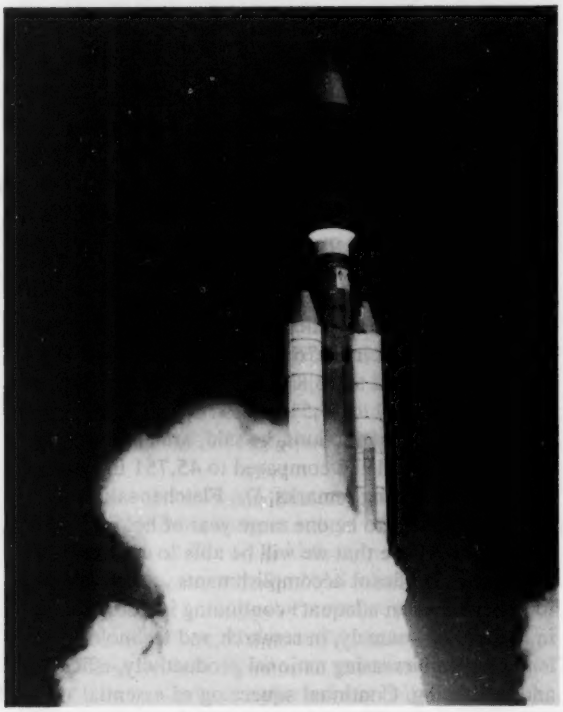
The CTS program is the responsibility of the Office of Applications at NASA headquarters; project management has been assigned to the Lewis Research Center. The Office of Tracking and Data Acquisition will provide tracking and data acquisition support.

The Delta launch vehicle project is managed for the Office of Space Flight by the Goddard Space Flight Center. Launch site operations are managed by the Unmanned Launch Operations Directorate at the Kennedy Space Center.

Solar Probe Satellite Placed in Orbit

Helios 2, the second of two spacecraft designed to fly closer to the Sun than any previous manmade object, was launched from Cape Canaveral's Complex 41 on Jan. 15, aboard a Titan/Centaur booster. The spacecraft, launched by NASA for West Germany, was put into a high elliptical orbit to circle the Sun at distances ranging from 150 million kilometers (93 million miles) to 43 million km. (26 million mi.).

West German Satellite Enroute to Probe the Sun—Helios-2 was launched from Cape Canaveral via Titan-Centaur-5 in January. The spacecraft, launched by NASA for West Germany, will fly closer to the Sun than any manmade object. The launch was conducted by the Kennedy Space Center's Unmanned Launch Operations Directorate.



It will come closest to the Sun 93 days after launch and every 186 days thereafter.

Helios, named after the ancient Greek sun god, was built by West Germany as part of a joint venture with the United States. Three of ten experiments on board are for the U.S., seven are German. The U.S. supplies the launch vehicle, tracking and data acquisition, and technical support.

The Goddard Space Flight Center has overall project responsibility for U.S. participation, and the Lewis Research Center manages the Titan Centaur rocket. Telemetry data acquisition and tracking are provided by the Jet Propulsion Laboratory, which manages the Deep Space Network. After initial

maneuvers were monitored by a German team at JPL, spacecraft control was transferred to a German team at the German Space Operation Center near Munich.

Helios 2 will fly nearly 3 million km. (2 million mi.) closer to the Sun than its predecssor, Helios 1, launched a year ago. It will be subjected to about 10 percent more heat than Helios 1, which withstood temperatures of 370 degrees C. (700 degrees F.), high enough to melt lead.

Instruments aboard Helios 2 will measure the solar wind (ionized particles given off by the Sun), magnetic fields, solar and galactic cosmic rays, electromagnetic waves, micrometeoroids, and the zodiacal light (a diffuse glow sometimes seen in the east and west before sunrise and after sunset). Information returned by the spacecraft is expected to provide additional data concerning unexpected micrometeorite results obtained by Helios 1 instruments.

GSFC's Dr. James Trainor, the U.S. project scientist, explains:

"Helios 1 detected about 15 times more micrometeorites from a distance of 53 million kilometers (33 million miles) than had been observed from closer to Earth. They come from many different directions at different times.

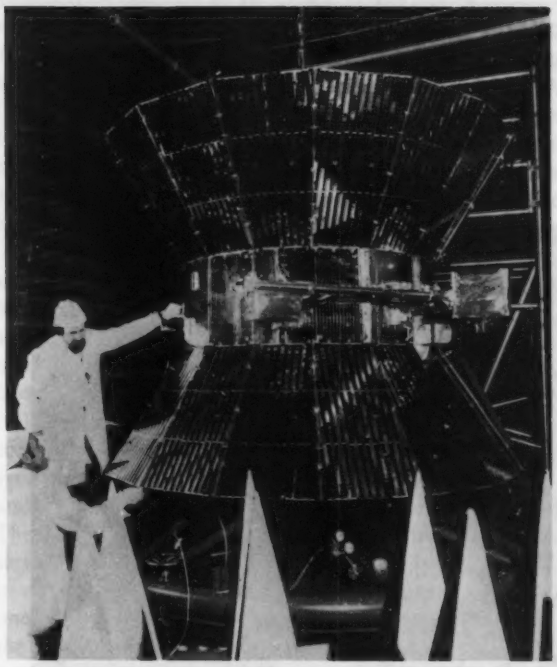
"We don't know whether they are transported by the Sun's corona after being pulled into the Sun from elsewhere in space—which would have an important impact on solar energy transport theory—or whether they may be following the path of starlight directly in towards the Sun."

Trainor notes that Einstein's theory of relativity predicts that the immense gravitational attraction of the Sun bends light beams from distant stars in toward the Sun as light passes by.

Instrumentation similar to that carried on Helios is carried on two Interplanetary Explorers (47 and 50) in Earth orbit; on the Pioneer spacecraft orbiting the Sun at about one Astronomical Unit*; and on Pioneers 10 and 11, in the outer reaches of the solar system. Data received by those spacecraft, which measure solar phenomena from various points in the solar system over a long period of time and under varying conditions, will be correlated with those received from the two Helios probes.

Germany's Federal Ministry for Research and Technology has overall management responsibility for Helios and the German Aerospace Research and Experimental establishment serves as project manager.

The cost of the two Helios missions, including spacecraft and launch vehicle, is about $260 million. The German share of about $180 million pays all spacecraft costs, including the price of the two flight units, a prototype, and thermal, structural and engineering models. Germany provides seven experiments, plus command and data acquisition costs for the German ground stations.



Helios Spacecraft Readied for Launch—Helios-2, a joint U.S.-West German project, undergoes checkout procedures in West Germany just before shipment to Kennedy Space Center, Fla. Launched aboard a Titan Centaur rocket Jan. 15, 1976, it will investigate solar winds and other solar phenomena. Helios-2 will orbit the Sun at distances of 43 million km. (27 million mi.) to 150 million km. (90 million mi.), closer than any other satellte in history, and will be subjected to extremely high temperatures ranging to 370 degrees C. (700 degrees F.).

The U.S. cost is about $80 million for the two launch vehicles and their support, tracking and data acquisition services for three of the ten experiments, and for other support.

Prime contractor for the spacecraft is Messerschmitt-Bolkow-Blohm GmbH, Munich. The Martin Marietta Corp., Denver, Colo., builds the Titan III booster under contract to the U.S. Air Force Space and Missiles System Organization, acting as the procurement agency for the Lewis Research Center. The Centaur upper stage is produced by General Dynamics/Convair and the TE–364–4 stage is provided by McDonnell Douglas Corp. Launch site operations are managed by personnel at the Kennedy Space Center, Fla.

* One A.U. = 149,599,000 km. or 92,751,380 mi.

Wallops Launch Produces Multi-colored Cloud

Artificial clouds appearing as white puffs and a blue-green trail were visible over a large portion of the eastern seaboard for two days in late January. The clouds were formed by chemicals released by two sounding rockets launched from NASA's Wallops

Colorful Clouds, Courtesy of NASA—When chemical payloads launched from NASA's Wallops Flight Center (Va.) reach a certain altitude, they produce clouds such as those seen in this photograph, which appear as white puffs and a blue-green trail. The spectacular display can be seen over much of the eastern seaboard after launchings at sundown. The color effects are created by trails of sodium, lithium and barium.

Flight Center. The spectacular display was produced when the sounding rockets, launched just after sundown on the Earth's surface, reached an altitude where sunlight was reflected to instruments on land. The clouds were visible for about 10 minutes before being dissipated by the wind.

The sounding rocket firings were part of a research project into concentrations of electrons and ions in the D-region of the ionosphere, about 35 to 60 miles above the Earth. The D-region is where electrons influence radio communications.

Scientists are interested in the cause of abnormal winter behavior of the D-region, which produces high absorption of radio waves during the daytime. Ionization levels of the D-region are much lower and more stable during summer.

Computer Program Defines Water Areas

The Johnson Space Center has developed a computer program to produce surface water area maps, using digital data from NASA's Landsat Earth resources survey satellites. The maps are compiled at a relatively small cost, at any desired scale showing surface water areas in excess of six acres.

Maps of water resources can be obtained where no water inventory exists or to better determine the use of available water supplies. NASA's two Landsats scan about 95 percent of the Earth's land mass, making virtually all populated regions available for surface water maps.

The new system is called the Detection and Mapping (DAM) Package. User training is very brief, usually taking about one day, and no computer or remote sensing experts are needed to implement the water-mapping program. The DAM Package has been used by the U.S. Army Corps of Engineers to map water resources in Washington and Tennessee. The Texas Water Development Board and regional agencies in Oklahoma also have used the program for regional water mapping.

Second Space Processing Rocket to Be Launched

The second launch of a series of Space Processing Applications Rockets (SPAR) carrying space processing experiments is scheduled for May 4, 1976. The SPAR project uses a Black Brant VC sounding rocket and is fired from the Army's White Sands Missile Range in New Mexico. These low-cost rocket missions provide a means of obtaining space-processing scientific data in near-zero gravity.

SPAR Exhibit—Principal investigators for scientific experiments performed during the first Space Processing Applications Rocket mission pose before the SPAR exhibit at the Marshall Space Flight Center. The exhibit features the actual experiments cannister and recovery parachute used in the flight. Left to right are: Carolyn S. Griner, Dr. James W. Patten, Donald R. Uhlmann, Charles F. Schafer, Dr. Louis Raymong, and Robert B. Pond.

The first SPAR was successfully launched on Dec. 11, 1975 at 9:10 a.m., and the 143-kilogram (340-pound) science payload was recovered about 15 minutes after launch. The payload consisted of nine space-processing experiments designed and assembled at the Marshall Space Flight Center. All but one of the experiments will be used on two or more missions.

During the coast phase of the suborbital ballistic trajectory, about five minutes of near weightlessness is provided in which to obtain space-processing scientific data. The rocket reaches an altitude of about 225 kilometers (140 miles) and travels downrange at 80 km. (50 mi.). All SPAR payloads will be recovered by parachute for individual experiment analysis. The experiment processing apparatus will be reused on future missions.

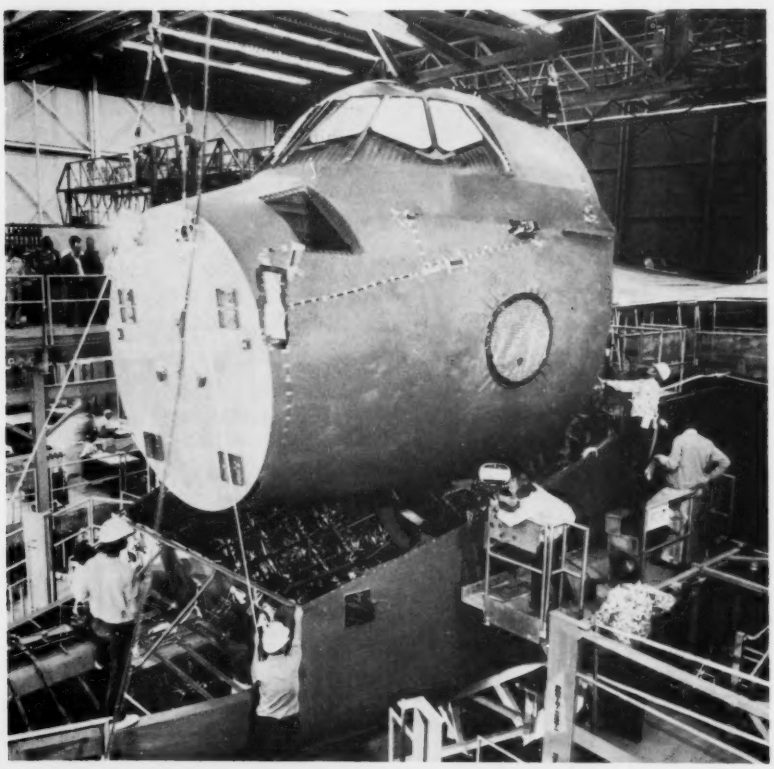
The SPAR project is managed for NASA's Office of Applications by the Marshall Space Flight Center. The Goddard Space Flight Center provides the rocket system and directs launch and payload recovery activities.

Second Improved Intelsat Launched

Intelsat IVA F–2, the second in a series of improved Intelsat commercial communications satellites, was launched successfully by an Atlas-Centaur launch vehicle from Cape Kennedy, Fla. on Jan. 29, 1976. The Atlas-Centaur project is managed for the Office of Space Flight by the Lewis Research Center. The Unmanned Operations Directorate at KSC is responsible for launch site operations. The Office of Applications conducts preflight testing to assure launch readiness and compatibility of Intelsat spacecraft with NASA launch vehicles and launch environmental conditions.

Twenty-two Intelsat satellites have been launched since April 1965. Of five mission failures, two were because of onboard propulsion (apogee motor) anomalies and three were caused by launch vehicle malfunction. Except for the latter three, all NASA launch support objectives have been met.

The current global system of communications satellites consists of four Intelsat IV satellites operating in synchronous equatorial orbit over the Atlantic, Pacific and Indian Oceans, and a spare over each area. The Intelsat IVA F–1, the first of the improved IVA series, was launched in September 1975. It is scheduled to replace the primary satellite over the Atlantic Ocean once the Intelsat IVA F–2 is placed in operation as the back-up to Intelsat IVA F–1. The Intelsat IVA satellites have almost two-thirds greater communication capability than the Intelsat IV series. ■ ■ ■ ■



Orbiter "Head Shed"—Taglines and many eyeballs assure careful lowering of the crew compartment into Space Shuttle Orbiter 101's forward fuselage. The compartment, which will house the crew of the nation's first reusable spacecraft, was mated to Orbiter 101 early in January at Rockwell International Space Division's assembly plant in Palmdale, Calif. Rollout of first Orbiter is scheduled for fall of 1976, with initial landing tests slated for mid-1977.

Chief for New Unit at NASA

Philip E. Culbertson

The Office of Planning and Program Integration was established at NASA headquarters in late January. Philip E. Culbertson concurrently was named assistant administrator for the unit.

The OPPI will develop and maintain the agency's plans for long-term use of the Space Transportation System and will integrate and represent user requirements for the STS.

Culbertson has been a NASA employee since 1965, serving in several jobs with the manned flight programs. He was director of project integration for Apollo application programs and director of the Advanced Manned Mission Program. He was with General Dynamics Corp for 11 years before joining NASA.

Culbertson holds a B.S. degree in aeronautical engineering from Georgia Tech and an M.S. degree in aeronautical engineering from the University of Michigan.

Space Meals for Housebound on Earth

NASA experiments with the ultimate in convenience foods eventually may help to provide the nation's elderly with three square meals a day. Food technology and packaging techniques developed by the Johnson Space Center to feed Apollo and Skylab crews during space flights are being studied in a pilot program that may help provide balanced meals to elderly and infirm people who live alone.

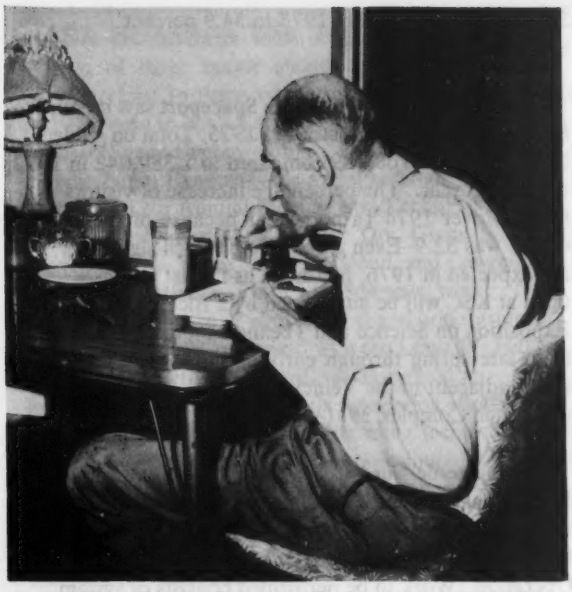
Physicians, nutritionists and biomedical engineers at the center are working together to design and develop a meal system to supplement programs now carried on by the National Nutrition Programs for the Elderly organization. A primary objective is to develop food items that need only the addition of hot water for reconstitution or are packaged in foolproof, easily-opened, compact containers.

The project is part of NASA's Technology Utilization program in which space-developed technology is applied to solutions of Earthbound problems. The new program is called "Meal Systems for the Elderly." Project engineer Gary R. Primeaux said that its goal is "to develop nutritious, shelf-stable, convenient and easily deliverable meals for the elderly." He added that surveys have shown that getting a balanced daily meal is not easy for a great many old people for a variety of reasons: a lack of single-serving products, limited mobility of individuals, loss of skills needed to prepare balanced meals, limited finances and often a sense of loneliness or rejection that reduces the incentive to cook and eat nutritious meals alone.

Although several programs for home-delivered hot lunches are being tried in various cities, a foolproof system has not been developed. For instance, weekend service is usually lacking and food spoilage risks are high. The NASA investigators are hoping to come up with a shelf-stable, multi-meal package that can be distributed by several methods—even by parcel post—to old people who live beyond the range of hot-meal delivery or to those living in cities where weekend meals are not provided.

Basing their experiments on a 3,000-person clientele, the team is working toward a basic meal consisting of an entree, two side dishes, dessert and beverage, which can be opened, cooked, eaten and cleaned up by solitary elderly people. The menu, based on a 21-day cycle, offers a list of 10 entrees, 20 side dishes, 10 desserts and five beverages. Combinations will provide at least one-third of the daily dietary requirements. A typical menu consists of: a beef pattie, scalloped

Someone's in the Kitchen—Food technicians at the Johnson Space Center food laboratory package a batch of meals to be evaluated in field tests by elderly people who either live alone or have trouble preparing nutritional balanced meals. The technology involved originated with Apollo and Skylab space flights. Physicians, nutritionists and biomedical engineers at JSC are workng on a pilot plan to help the elderly with a meal system that can supplement the existing National Nutrition Programs for the Elderly.



An Old-Timer Samples Space-Age Cookery—An elderly volunteer in Central Texas taste-tests one of the prepared meal packages being developed by Technology Utilization personnel at JSC. The pilot program uses many of the techniques developed at NASA to provide meals to Apollo and Skylab astronauts. Its goal is to provide tasty, nourishing meals that can be prepared with minimum effort. Dinner may consist of an entree, two side dishes, dessert and a beverage, all packed in disposable materials.

potatos, mixed vegetables, French apple dessert and chocolate instant drink.

A field demonstration of the program began in January and will continue through April, in which theories are tested as aged Texans prepare and eat test meals. Design, development, field demonstration and evaluation phases of the program should be completed by late 1976.

In this cooperative enterprise, JSC is developing the meal system technology; the University of Texas Lyndon B. Johnson School of Public Affairs, Austin, is assisting in demonstrations and the distribution of meals; and the Texas Research Institute of Mental Sciences, Houston, conducts surveys of attitudes, food preferences and taste tests among potential users.

The estimated cost of the program is $240,000, broken down as follows: $125,000 to be paid by NASA; $90,000 by the Johnson School of Public Affairs; $8,000 by the Texas Research Institute; and $17,000 by United Action for the Elderly, Inc. Contractors in the development program are Technology, Inc., and the Martin Marietta Corporation.

NASA Publishes Apollo Book

A lavishly illustrated, 324-page book called "Apollo Expeditions to the Moon" was recently published by NASA. It was written by 18 key members of the team that successfully planned and carried out the moon landings, and edited by Edgar M. Cortright, former director of the NASA Langley Research Center. Cortright says that the purpose of the book is "to record the story of Apollo before the colors fade and memories blur."

The volume's 15 chapters tell the dramatic story of what are perhaps the most exciting and challenging scientific voyages in modern history. The foreword is by NASA Administrator Dr. James C. Fletcher, and the introduction is by Dr. Robert C. Seamans, Jr., former NASA Deputy Administrator. Seamans is now Administrator of ERDA.

The full-color book is published by the NASA Scientific and Technical Information Office. It is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, priced at $8.90.

New Chief of Industry Affairs

Paul D. Hauler

Paul D. Hauler has been named Director of Industry Affairs for NASA's Office of Industry Affairs and Technology Utilization. In the newly established position, he will serve primarily as the point of contact between NASA and the nation's aerospace industry.

Before joining NASA, Hauler served for three years as director of marketing for Boeing Electronics in Seattle. Previously, he worked for 17 years in product and sales managerial positions with various divisions of the General Electric Company.

Born in Oswego, N.Y., Hauler received his A.B. degree from Colgate University in 1956.

SRB Contract Is Issued

A $1.190 million contract has been issued by the Marshall Space Flight Center for electronics items to be used in the Space Shuttle Solid Rocket Booster (SRB). The recipient is the Eldec Corp. of Lynnwood, Wash., which will supply various components including development of the dedicated signal conditioner for flight instrumentation, and signal conditioner modules for operational flight instrumentation for the SRB. The corporation will fabricate, acceptance-test and deliver some 552 items during 1976 through 1978, making deliveries each quarter.

Did You Know?

Public drive-through tours of the Kennedy Space Center and Cape Canaveral Air Force Station were resumed on Jan. 18, after a 127-day interruption in which pickets at Gate 2 prevented Sunday drive-through tours. Access is available from 9 a.m. to 3 p.m. through Gate 1, the south entrance to Cape Canaveral AFS; Gate 2, the south KSC entrance via State Road 3 from Merritt Island; and Gate 3, the west KSC entrance via State Road 405. The drive-through tour route takes visitors through KSC's Complex 39, site of the launch of the astronauts to the Moon; the KSC industrial area; Cape Canaveral's active and historic launch sites; and the Air Force Space Museum.

The "Space Doctor," Clarence A. Jernigan, who watched over the health of astronauts for eight years, now practices medicine in a 100-year-old medical facility in Gaza, Palestine. Dr. Jernigan began his space career as one of three physicians taking care of the astronauts and their families in 1964. He was flight surgeon at various tracking stations for the first three manned Gemini missions, then became chief of the flight medicine branch at the Johnson Space Center in Houston. Throughout most of the Apollo program, Jernigan shared with two other physicians the responsibility for leading the pre-flight and post-flight medical examining team.

The Bendix Field Engineering Corp., Columbia, Md., has been awarded a contract to operate and maintain portions of NASA's worldwide Spaceflight Tracking and Data Network. The two-year, cost-plus-award-fee contract is about $104 million. It contains a provision for the negotiation of up to three additional one-year extensions. The worldwide STDN is operated to meet the tracking and data acquisition needs of NASA's Earth orbital space programs, both manned and unmanned. The contract will be supervised by the Goddard Space Flight Center.

The U.S. Civil Service Commission recently reported that women employed in full-time white-collar jobs in the Federal government increased by 38,843 in the year ending Oct. 31, 1974. A CSC survey showed that women represented 61 percent of the overall net increase of 63,677 in Federal white-collar jobs in the one-year period, raising their representation in the white-collar work force by nearly one percent—from 34.0 percent in October 1973 to 34.9 percent a year later.

The Kennedy Space Center's Spaceport saw its third busiest visitor year in history in 1975. Total on guided bus tours was 1,168,189 compared to 1,389,042 in 1972, the record year. The percentage increase of visitors in 1975 over 1974 (a poor year because of the energy crisis) was 32.9 Even greater numbers of sightseers are expected in 1976, inasmuch as tourist attractions at KSC will be augmented by a Bicentennial Exposition on Science and Technology, to be presented from late spring through early autumn. The Exposition site is adjacent to the Vehicle Assembly Building at Launch Complex 39.

Aeronutronic Ford Corp. contract at Johnson Space Center recently was extended for six months. A supplemental agreement authorized the extension with the Houston-based Space Information Systems Operation. Work to be performed consists of system engineering and integration, maintenance, operations and other support functions including logistics, reliability and quality assurance for the Mission Control Center and various other ground-based data systems managed by the JCS. Under a cost-plus-award-fee contract, the estimated value of the supplement is $10,690,633, bringing the total value to $278,400,000.

Technicolor Graphic Services, Inc., Hollywood, Calif., recently was awarded a contract with the Johnson Space Center for photographic support services. Technicolor will be responsbile for management and operation of the motion picture, precision, metric and still laboratories, laboratory analysis and support, and audiovisual support at JSC. The cost-plus-award-fee contract was awarded for one year beginning Jan. 1, 1976; estimated amount is $2,242,000.

A concept verification test program has been in progress since 1972 at the Marshall Space Flight Center to determine whether commercially available scientific equipment can be used for research in space with little or no modification. The high cost of new designs for the wide variety of instruments required for support of Spacelab's many planned scientific experiments makes it practical to explore the suitability of available instrumentation. Test areas include acoustics, vibration, electromagnetic interference, humidity, thermal and offgassing. Several instruments also were tested for zero-g effects in KC–135 aircraft flights. Systems under scrutiny relate also to mounting techniques, air-flow cooling systems, the use of the same instruments for more than one experiment, isolation from radiation effects and containment of loose material in Spacelab. ■ ■ ■ ■

NASA Scientists Win Top AIAA Awards

Two of three major awards given each year by the American Institute of Aeronautics and Astronautics in 1975 went to NASA scientists stationed at the Johnson Space Center. Honored at the recent AIAA Honors Night Banquet—the social highlight of the Institute's 12th Annual Meeting and Technical Display, held in Washington, D.C.—were Drs. Glynn S. Lunney, manager of the Space Shuttle Payload, and Lawrence F. Dietlein, deputy director of Life Sciences, who received certificates of appreciation and honorariums.

Dr. Lunney was presented with the Louis W. Hill Space Transportation Award, which carried an honorarium of $5,000, "for his pioneering efforts in manned space flights. His outstanding technical ability and management expertise have contributed significantly to the success of every United States manned space flight program."

Dr. Dietlein won the John Jeffries Award, which included an honorarium of $500, "for his most significant contributions to space medicine in Skylab by assuring the quantification of physiological changes/adaptation caused by weightlessness."

The third award was received by Stanford S. Penner of the University of California.

JSC's Deputy Director Sigurd A. Sjoberg was named an AIAA Fellow at the organization's Washington meeting.

JSC Scientists Live in Simulated Spacelab

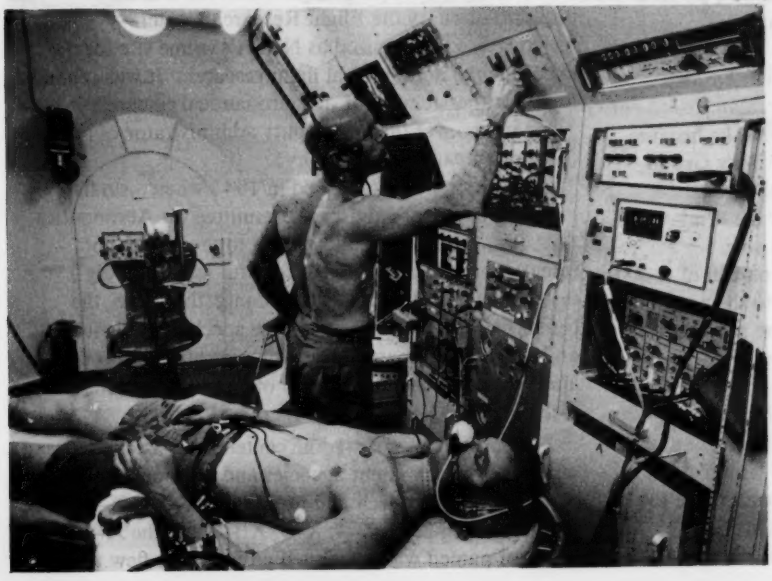
A team of three space scientists lived and worked for a week inside a mockup of the Space Shuttle Spacelab at NASA's Johnson Space Center. In an around-the-clock series of experiments, the men ate, slept and performed a variety of space-related chores in the 6.8-meter (22-foot) by 4.06-m (13-ft.) chamber, which is a mockup of the Shuttle orbiter crew compartment.

The team consisted of astronaut-physician Dr. Story Musgrave, who directed the more than 20 experiments in space medicine and one in space physics conducted aboard the mockup; Dr. Robert C. Clarke, a nuclear-chemist in the Planetary and Earth Sciences Division; and Dr. Charles S. Sawin, a cardio-pulmonary physiologist with the Biomedical Research Division.

The week-long simulation, during which the scientific team followed a prescribed flight plan, was designed to evaluate proposed Space Shuttle ground support and flight crew operational procedures, data handling techniques, and integration concepts between man and machine; and to demonstrate the feasibility of the 21 experiments.

The three scientists maintained communication with flight operation engineers and scientists working outside the mockup at control stations. The mockup was constructed by members of the Bioengineering Systems Division and Technical Services Division at JSC. It is outfitted with instruments and experiments closely similar to those that will be installed in the real Spacelab in the 1980s. The simulation was planned and directed by the Life Science Directorate at JSC.

Spacelab is a project of the European Space Agency, an 11-country consortium that is funding and constructing the laboratory to be used aboard the Space Shuttle. The laboratory is designed to carry multi-discipline scientific payloads into space inside the payload bay of the Shuttle Orbiter.



Medics Test Space Medical Equipment—Dr. Story Musgrave (standing), wears various bio-sensors as he administers cardio-vascular tests to Dr. Charles S. Sawin, inside a mockup of the Space Shuttle Spacelab at NASA's Johnson Space Center. The sensors attached to Dr. Sawin report details of cardiovascular factors into the instruments lining the wall. The instrument-laden chair in background is used to test vestibular functions in humans—particularly reaction to motion as the chair is rotated. Vestibular tests reveal information concerning susceptibility to motion sickness. Three space scientists lived in the mockup vehicle for a week while carrying out more than 20 experiments in medicine and physics.

Dr. Hugh Latimer Dryden
1898-1965

A giant in the annals of flight research, Dr. Hugh L. Dryden was born in 1898 in Pocomoke City, on the eastern shore of Maryland. He saw his first airplane, the *Antoinette*, in Baltimore in 1910, and wrote an essay about aircraft a few days later. Years later, he was fond of remarking: "The airplane and I grew up together."

Dr. Dryden graduated with honors from Johns Hopkins University in 1916 and earned his Master's Degree two years later.

He joined the National Bureau of Standards in 1918 and was soon working in its newly created wind-tunnel section. During this time, he studied under Dr. Joseph S. Ames, a member of the new National Advisory Committee for Aeronautics (NACA) and earned his Doctorate of Physics at age 21. The title of his doctoral thesis was "Air Forces on Circular Cylinders." That marked the beginning of a brilliant career in the science of aeronautics which was devoted to the study of airflow, its problems of turbulence, and especially the problems of the boundary layer—that sluggish layer of air that tries to cling to any body in flight. His work in these areas brought him widespread recognition in the U.S. and abroad.

In 1924, Dr. Dryden made some of the earliest scientific investigations of airfoils at flows up to and even slightly beyond the speed of sound. These and other studies led to the creation of improved facilities, making possible the research that resulted in laminar flow wings of aircraft such as the P–51.

Following World War II, during which Dr. Dryden worked with the Office of Scientific Research and Development on the design of guided missiles, he became deputy director of the USAF Scientific Advisory Group headed by Dr. Theodore von Karman. That group was flown into occupied Germany to study the results of German aeronautics research during the war.

In 1947, Dr. Dryden became the senior official of NACA and two years later was appointed to the newly created post of director. In that position, he played a key role in the formation of the research airplane committee that provided the guiding policy for the series of high-speed research planes that culminated in the X–15.

Following the 1957 launch of the Soviet Union's Sputnik 1, NACA and several other agencies became the nucleus of NASA. Dr. Dryden became the first Deputy Administrator, a post he held until his death. NASA's early years were greatly influenced by his presence.

In addition to his professional work, religion was important to Dr. Dryden. He was a licensed preacher for 45 years. One of his sermons perhaps best describes his legacy: "None of us knows what the final destiny of man may be, or if there is any end to his capacity for growth and adaptation. Wherever this venture leads us, I am convinced that the power to leave the Earth—to travel where we will in space and return at will—marks the opening of a brilliant new stage in man's evolution."

A sampling of the many honors bestowed on Dr. Dryden includes the President's Award for Distinguished Civilian Service, the Langley Gold Medal of the Smithsonian Institution, the Daniel Guggenheim Medal, the Wright Brothers Memorial Trophy, and the Robert A. Goddard Memorial Trophy. His honorary degrees, awarded in the U.S. and overseas, numbered 16.

Dryden's career was devoted to solving the problems of turbulence—in the realm of aeronautics and in the affairs of men. As far as any one man's influence can be felt, he was incredibly successful on both counts.

NASA Field Installations:

Hugh L. Dryden Flight Research Center
Edwards, Calif.

This is the first of a series of profiles of NASA field centers. "NASA Activities" will contain additional reports in subsequent issues covering the history, function and outlook of other NASA centers.

The Hugh L. Dryden Flight Research Center—until last January the Flight Research Center—has long been recognized as NASA's prime site for experimental aeronautical flight research. It was renamed to honor the memory of the aeronautical research pioneer who was the first deputy administrator of NASA (see accompanying biography).

The center was established in 1947 when a small group of National Advisory Committee for Aeronautics (NACA) personnel was assigned to the X–1 flight research program, the first successful attempt to fly faster than the speed of sound. Since that time, the center has specialized in flying the specially designed and highly instrumented research aircraft that are now among the most valuable tools of advanced aeronautical research.

In addition to the X–1, the center has participated with other Government agencies and aerospace contractors in research and testing the X–1A, X–1B, X–1D, X–1E, X–3, X–4, X–5, XB–7 and the X–15. The last named was a manned aircraft that flew at six

and one-half times the speed of sound and at altitudes of 165,000 meters (350,000 feet).

Wingless lifting body aircraft flown at the Dryden Flight Research Center have demonstrated technology that is paving the way for the Space Shuttle, the vehicle that will bridge the gap between space flight and flight in the Earth's atmosphere and will lead the way to the world's first economical, reusable space transportation system. The Shuttle will be operational in the 1980s.

Current efforts at the Center are aimed at developing methods of alleviating the dangerous effects of wing tip vortices which trail from wide-body jets now in operation, developing advanced flight control systems that may lead to more efficient air travel, demonstrating in flight new airfoil designs that should use less fuel and may lower operating costs of future airliners. Under flight-testing is the triple-sonic YF–12 to help the designers of future supersonic aircraft, both military and civilian. In addition, engineers at the center are using techniques developed to reduce aerodynamic drag of high-speed aircraft to modify the shape of trucks and trailers for increased fuel economy.

The center will be the site of the approach and landing tests of the Space Shuttle Orbiter, as well as the recovery site of the first several manned orbital flights of the Shuttle.

Recent accomplishments recorded at the California center include the following:

More than 200 pure research flights were flown from the Dryden Center in 1975, and an additional 1,000 flights were flown by center pilots in support of those research flights.

The rocket-powered X–24B, successor to the lifting body aircraft tested at Dryden, made two hard surface runway landings and completed the joint USAF/NASA test program. Under consideration is a hypersonic version, the X–24C.

The F–111 Transonic Aircraft Technology (TACT) aircraft completed its original test program and is currently flying tests with simulated bombs to evaluate whether the change in configuration will affect the efficiency of its supercritical wing. The supercritical wing shape, developed by NASA, has proven most effective in increasing maneuverability.

Another NASA/USAF test program, the F–111 with an Integrated Propulsion Control System (IPCS), made its first flight using the computer-controlled inlet system, which should allow aircraft to be flown at full performance limits without adverse interaction.

The center's two triple-sonic YF–12 aircraft (see cover) were flown together for the first time in research programs to test the effects of extremely high temperatures on metals.

Mothership and Flock—An aerial view taken at the Dryden Flight Research Center shows the wide variety of research and experimental aircraft being flown at the NASA center. The B-52 in the foreground is the "mothership" that has been used to airlaunch the X-15 rocket plane, the M-2, HL-10 and X-24 lifting bodies as well as several unmanned remotely piloted research vehicles.

Lightning-fast Aircraft—The X-1A and X-1B, on the runway at the Hugh L. Dryden Flight Research Center, are modified versions of the original X-1, the first plane to break the sound barrier. The X-1A reached a record speed of Mach 2.5; the X-1B was a pioneer in flight testing of reaction controls at high speeds and altitudes.

Two full-scale F–15 fighters are on loan to the center from the Air Force for an undetermined period. One of these aircraft made its first flight during the past year. The craft will be used to validate data received from another program and to determine the cause of discrepancies between predicted and measured values of drag, and to develop improved methods of prediction.

The Mini-Sniffer, a radio-controlled prototype model that will take high altitude samplings of air, made several flights and attained a peak altitude of 17,000 feet.

New software for the digital fly-by-wire F–8 aircraft has been installed and checked out. The new system is a prototype of the flight controls to be used on the Space Shuttle. First flight is scheduled for May of this year.

The center presently has 495 employees in the following categories: scientists and engineers, 184; professional administrative, 51; clerical, 44; and 216 technicians, including sheet metal workers and machinists, aircraft mechanics and technicians, and electronics technicians. Employees are divided among six directorates: Office of the Director (including Safety and Quality Assurance); Projects; Data Systems; Flight Operations and Administration; and Program Support. Another 100 maintenance employees, reporting to Serv-Air, Inc., work at the center.

Dr. David R. Scott became Director of the Dryden center in 1975. Dr. Scott, who logged some 550 hours in space was an astronaut on Gemini 8 and Apollo 9, and was spacecraft commander on the lunar-landing Apollo 15. He is one of three astronauts who have flown both Earth orbital and lunar Apollo missions. He retired from the Air Force in 1975 with the rank of colonel and more than 5,600 hours of flying time.

Located on the edge of Rogers Dry Lake in the Mojave Desert, the center—which occupies about 510 acres of the 301,000-acre Edwards Air Force Base—conducts its test operations over one of the most remote and barren sections of the country. The area consists largely of a complex of dry lakebeds, extending throughout southern California and Nevada, which provide an almost unlimited selection of long unpaved runways for emergency use. On many occasions these lakebeds have been used to make safe recoveries of both research and operational aircraft, including the X–15 and the XB–70.

In addition to its complex of unpaved lakebed runways, Edwards also has available a 15,000-foot paved runway which is capable of handling the largest aircraft flying today.

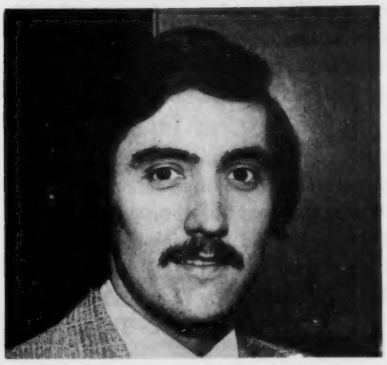
Over its 25 years of existence, the Dryden center has developed a unique and highly specialized capability

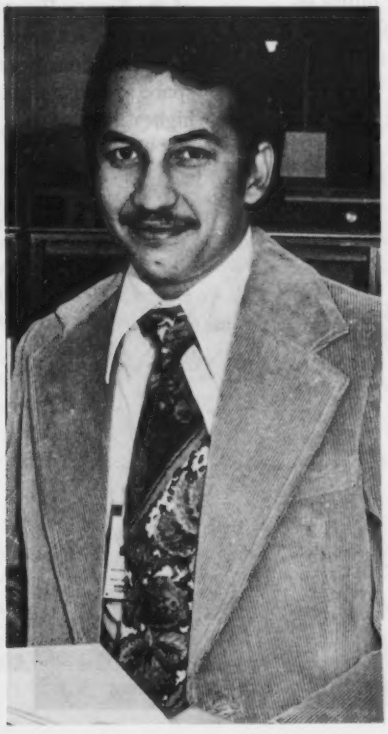
From Astronaut to Center Director—Dr. David R. Scott, director of NASA's Hugh L. Dryden Flight Research Center since 1975. Scott flew on Gemini 8, Apollo 9 and was spacecraft commander on Apollo 15. On the Gemini 8 mission (1966), Scott and Neil Armstrong performed the first successful docking of two vehicles in space. Scott retired from the U.S. Air Force in 1975, with the rank of colonel and more than 5,600 hours of flying time.

for conducting flight test programs. The analytical procedures, instrumentation and data acquisition facilities, and the highly developed test techniques used there have greatly assisted the aircraft and aerospace industries in meeting many difficult challenges in the past.

In a recent comment at a budget briefing (for FY 1977) Deputy Administrator George M. Low spoke of the essential role of aeronautical research and development to NASA and to the nation: "The aeronautics budget is increasing again. It has increased essentially every year, at least that I have been here. Let me tell you for a moment why. Aeronautics is a very important aspect of our national economy. Just a few numbers: Seventy percent of all the transport airplanes in the free world are U.S.-built. This brought, last year (1975), $6 billion into the United States—second only to agricultural exports. . . . If we look at civil transports only and project for the next 10 years of what will be bought by the free world, we are looking at about $50 billion worth of aircraft. If the U.S. maintains its share of the market, we can sell more than $40 billion worth of airplanes. . . . How do we maintain this? Only by having better airplanes, more productive airplanes, only by having the best available technology. So, the punch line is that new technology is needed to capture the next generation of aircraft sales."

Tripping the Light Fantastic—Mr. and Mrs. Edward Ireland (he is 95 years old), dancing the polka, were winners of a dance contest held at the Langley Research Center. The Center sponsored a Senior Citizens Holiday Festival at year's end to acquaint local elderly people with work done by the space agency, including medical benefits provided by space research. The couple lives at the Baptist Home, Newport, News, Va.





Goddard Welcomes New Engineers—Eduardo Torres (top left), Jose Flores (lower left), and Jose Lugo were recently hired for engineering jobs in the Communications and Quality Assurance Division at the Goddard Space Flight Center, Greenbelt, Md. The three obtained their degrees in electronic engineering at the University of Puerto Rico, from which they were recruited by Dora Puleo, the Spanish program coordinator at Goddard.

Management Shifts at JSC

Increasing demands of the Space Shuttle Program have resulted in the following three management changes at the Johnson Space Center: Kenneth S. Kleinknecht was named as assistant manager of the Orbiter Project, Space Shuttle Program; George W. S. Abbey was made acting director of Flight Operations, replacing Kleinknecht; and Henry E. Clements was appointed acting technical assistant to the JSC director, Dr. Christopher Kraft, replacing Abbey. The Space Shuttle, scheduled to become operational in 1980, is a reusable vehicle expected to replace virtually all U.S. space launch vehicles. The Orbiter section will be used to deploy and retrieve satellites and serve as a carrier for Spacelab, the manned laboratory under development by the European Space Agency.

Physicist Is Appointed to Headquarters Post

Dr. Anthony J. Calio

Dr. Anthony J. Calio was appointed Deputy Administrator for Space Science in late November, succeeding Dr. John M. Thole, who joined private industry several months earlier. Dr. Calio reports to Dr. Noel W. Hinners, Associate Administrator for Space Science, under whose direction Calio discharges the duties of general manager in OSS. He is responsible for day-to-day program evaluation and direction.

Dr. Calio joined NASA in 1963, serving first at the no-longer-operating Electronics Research Center, then at OSS in NASA headquarters. In 1968, he transferred to the Johnson Space Center, where he served as director of science and applications from 1969 to 1975.

He earned his B.A. in physics from the University of Pennsylvania in 1953, and did graduate work in physics there and at the Carnegie Institute of Technology. In 1974, Calio received an honorary D.Sc. from Washington University in St. Louis. He was selected as a Sloan Fellow for the 1974-75 program at Stanford University.

Dr. Calio was awarded the NASA Distinguished Service Medal in 1973 and the NASA Exceptional Service Medal in 1969. He is a member of the American Association for the Advancement of Science, the American Geophysical Union, and the New York Academy of Sciences, as well as an associate fellow of the American Institute of Aeronautics and Astronautics.

Astronaut Slayton Is Honored

Donald K. "Deke" Slayton was the 1975 recipent of the "American of the Year" award, presented during halftime ceremonies of the Bicentennial American Bowl College All-Star game in Tampa, Fla., Jan. 10. The nationally televised game was sponsored for the eighth year as a charity event by the International Association of Lions Clubs. This year's bowl game marked the beginning of the official Bicentennial celebration in Tampa. In making the award to Slayton, the chairman of the Tampa Bicentennial Council Sports Committee said: "We are delighted that Deke Slayton will accept this prestigious honor. He is truly an outstanding space scientist and represents a real American of the highest ideals."

Touching Bases—Herbert J. Rowe (right) recently appointed Associate Administrator for External Affairs, on a tour of the Langley Research Center. He is shown with Ransom Ritter, assistant manager of the visitor center, in front of an Apollo capsule.

Presidential Recognition—Cost reduction suggestions earned signed and framed letters of recognition from President Ford for six Marshall Space Flight Center employees. Presenting the awards in this photo is MSFC director Dr. William R. Lucas, flanked by (left to right) Linda N. Maddox, Samuel B. Wynn, Jr., Curtis Ray Helms, Jack L. Matheney, Jan C. Monk and Charles S. Gillespie

NASA Film Announcements

"The Mission of Apollo Soyuz," a 28-minute film that documents events as they occurred on the US/USSR link-up in space, was released in January. It highlights the buildup to the mission and looks to the future for other planned international cooperative ventures in space.

The NASA film, "The Time of Apollo," won a Silver Medal Award (second place) at the Festival of the Americas held in the Virgin Islands.

"Four Rooms—Earth View" received a Silver Award (second place) at the 18th International Film and TV Festival in New York.

"Five Minutes to Live" received a Silver Hugo Award (second place) at the 11th Chicago International Film Festival.

New NASA Publications

Observing Earth from Skylab explains and illustrates remote sensing by satellite for uses that relate to agriculture, geology, weather forecasting, ecology, oceanography, water resources, geodesy and mapmaking. The 20-page, four-color publication features a foldout map of the Skylab earth resources observation passes. It is for sale by the Government Printing Office, Washington, D.C. 20402 for $1.00 per copy. (NASA NF–56)

Why Survey from Space? defines surveying; identifies local, state and national users of survey information; discusses methods and techniques and tells how to obtain photographs of Earth taken from space. The 12-page publication is for sale by the Government Printing Office, Washington, D.C. 20402, for $.45. (NASA NF–57)

Lunar Sample Exhibits

The following is a schedule of lunar sample exhibits from Feb. 15 to Nov. 15 1976:

Massachusetts—Goddard 50th Anniversary, Auburn, March 16.
Wisconsin—Wisconsin Bicentennial Exposition and Conference, Milwaukee, March 25-27.
American Freedom Train—Houston, Texas, Feb. 17; Fort Worth, Feb. 24; Dallas, March ; Oklahoma City, Okla., March 12.
High Flight Foundation Bicentennial Mobile Space Museum—Texas, Feb. 17-22; Little Rock, Ark., Feb. 24-29; Oklahoma, March 2-7; Missouri, March 9-14.
Tennessee Valley Association-Bicentennial Caravan Itinerary—In Georgia: Atlanta, Feb. 16-23; Newnan, Feb. 24; Griffin, Feb. 25; Macon, Feb. 26-27; Cordele, Feb. 28; Americus, Feb. 29-March 1; Albany, March 2-3; Pelham, March 4; Thomasville, March 5; Valdosta, March 6-8; Douglas, March 9; Waycross, March 10; Brunswick, March 11-12; Savannah, March 13-16.
Alabama—Alabama Space and Rocket Museum, Marshall Space Flight Center, Huntsville.
Florida—Visitor Information Center, Kennedy Space Center.
Kansas—Eisenhower Library, 200 S.E. 4th St., Abilene.
Mississippi—The National Space Technology Laboratories, Bay St. Louis.
New York—United Nations Building, New York City.
Ohio—USAF Museum, Wright Patterson AFB.
Texas—Johnson Library, University of Texas, Austin; Visitor Information Center, Johnson Space Center, Houston.
Virginia—Visitor Information Center, Langley Research Center, Hamtpin.
Washington, D.C.—National Geogrophic Museum; Smithsonian Institution, National Air and Space Museum, 1000 Jefferson Drive; Washington National Cathedral.

Dr. Lucas

Dr. Stuhlinger

MSFC Officials Receive Awards—Dr. William R. Lucas, director of the Marshall Space Flight Center, recently was given the Holger N. Toftoy Award for outstanding technical management at the 24th annual awards banquet of the Alabama section, American Institute of Aeronautics and Astronautics. On the same occasion, a one-time only award was presented to Dr. Ernest Stuhlinger in recognition of his many contributions to aerospace science and to the Alabama region of AIAA. Dr. Stuhlinger's award was given to mark his retirement (in December) as associate director for science at MSFC.

Inventions and Contributions Board Monetary Awards

The Inventions and Contributions Board, at its meetings of April 24, May 29 and July 16, 1975, recommended that monetary awards be granted to the NASA employees and NASA contractor employees identified on the attached list for scientific and technical contributions to space and aeronautical activities. The recommendations were approved by the Administrator and the awards have been made.

Innovator(s)	Title of Invention and Contribution
AMES RESEARCH CENTER	
Charles C. Kubokawa	Fastener Apparatus
Wendell D. Chase	Vehicle Simulator Multiplaner Visual Display System
John Dimeff	A Method and Apparatus for Compensating Reflection Losses
GODDARD SPACE FLIGHT CENTER	
James F. McChesney, Jr.	High Voltage Distributor
Richard F. Schmidt	Variable Beamwidth Antenna
James P. Strong	Two Dimensional Radiant Energy Array Computers and Computing Devices
David H. Schaefer	
Richard Schmidt	Two Feed Dish Antenna Having Switchable Beamwidth
Raymond Kruger	Desorption Augment Spectrometer Analysis System
and	Quartz Crystal Microbalance Physical Desorption Spectrometer
Michael Fitzmaurice James B. Abshire	Polarization Compensator for Optical Communications
HEADQUARTERS	
Ernst M. Cohn	A Nongassing Nickel-Cadmium Type Battery
LANGLEY RESEARCH CENTER	
John G. Davis, Jr. David G. Stephens	Tube Fabricating Process
George W. Brooks	Flexible Ring Slosh Damping Baffle
John D. DiBattista	Anti-Meteoroid Device
and	Determining Particle Density Using Known Material Hugoniot Curves
H. Douglas Garner	Servo Valve
LEWIS RESEARCH CENTER	
Li-Chen Hsu	Catalytic Trimerization of Aromatic Nitriles and Triaryl-S-Triazine Ring Cross-Linked High Temperature Resistant Polymers and Copolymers Made Thereby
J. Anthony Powell Herbert A. Will	Process for Fabricating SiC Semi-conductor Devices
Bruce A. Banks	Method of Constructing Dished Ion Thruster Grids to Provide Hole Array Spacing Compensation
Russel A. Lindberg	High Temperature Capacitor
Daniel E. Sokolowski	Heat Exchanger
Willard D. Coles	Method of Manufacturing Composite Superconductors

MARSHALL SPACE FLIGHT CENTER

Hubert E. Smith John R. Rasquin Roy A. Taylor	Digital Computing Cardiotachometer
William J. Britz William A. Boshers	Rapid Activation and Checkout Device
Vincent P. Caruso Elbert J. Minter	An Improved Portable Peening Gun
George L. von Pragenau	A Space Vehicle
Robert R. Below	Optical Pantograph
George L. von Pragenau Irwin T. Morgan Clifton A. Kirby	Translatory Shock Absorbers for Attitude Sensors
William J. Britz Wililam A. Bosher	A Method and a System for Extinguishing a Fire within a Sealed Battery
Wililam A. Bosher William J. Britz James J. Kaufmann	Lead-Oxygen DC Power Supply System
Lott W. Brantley, Jr.	Solar Energy Absorber
Wayman N. Clotfelter Benjamin F. Bankston	Apparatus for Measuring the Ferrite Content of Austenitic Stainless Steel Weld Material
William J. Abernathy Lowell G. Snoddy	A Hanger
Robert J. Naumann	Carbon Monoxide Monitor
Donald E. Davis	Optical Pantograph
Lott W. Brantley, Jr.	Solar Energy Trap

BELL AEROSPACE

Nicholas C. Costakos *and*	A Deployable Flexible Tunnel

GOODYEAR AEROSPACE

Newton D. Brown Gordon L. Jeppeson	

JET PROPULSION LABORATORY

Earl R. Collins Marshall E. Alper	Automated Multi-Level Vehicle Parking System
Harvey A. Frank Aiji A. Uchiyama Gordon L. Juvinall	A Non-Gassing Nickel-Cadmium Type Battery
John E. Ohlson William F. Williams	System for Interference Signal Nulling by Polarization Adjustment
Gordon Wood	Simultaneous Acquisition of Tracking Data from Two Stations

LTV AEROSPACE CORPORATION

Alex P. Featherston Kent P. O'Kelly	Method of Fluxless Brazing and Diffusion Bonding of Aluminum Containing Components

MONSANTO RESEARCH CORP.

James A. Webster	Polymides of Ether-Linked Aryl Tetracarboxylic Dianhydrides

SPERRY RAND

Ray E. Marlow	A Remotely Operable Articulated Manipulator

STANFORD RESEARCH INSTITUTE

Tom N. Cornsweet Hewitt D. Crane	Eye Tracker

UNIVERSITY OF NORTH CAROLINA

Donald E. Davis	Optical Pantograph

USAAMRDL

John C. Wilson Craig S. Shaw	Exhaust Flow Deflector

Civil Service Commission Official Talks to NASA People— Jayne B. Spain, Vice Chairman of the Civil Service Commission, is shown as she addressed NASA personnel at the Langley Research Center. The theme of Ms. Spain's speech was to urge government employees to take more pride in their work, to "stand up and be counted . . . publicize achievements, make known the many accomplishments of Federal workers." She pointed out that 3.6 million Federal employees have been recognized over the past 21 years for ideas, inventions, and other achievements beyond their job responsibilities, and said: "I don't think I need to remind you that the first man to set foot on the moon was a career civil servant who had joined the NASA predecessor agency [NACA] right out of college and became a test pilot of supersonic experimental airplanes before he became an astronaut."

Projected Launch Schedule

(As of February 1976)

Name	Launch Date	Vehicle	Range	Mission Remarks
RCA-B	March 25	Delta	ETR	Second domestic communications satellite for RCA.
NATO-IIIA	April 22	Delta	ETR	Communications satellite in synchronous orbit to perform communications relay for NATO. Reimbursable.
LAGEOS-A	April 30	Delta	WTR	Demonstrate relevant space techniques that will contribute to the development and validation of predictive models for earthquake hazard alleviation, ocean surface conditions and ocean circulation.
Comstar-A	May	Atlas-Centaur	ETR	Domestic communications satellite for Comsat Corp. Reimbursable.
Relativity (Gravity Probe)	May	Scout	WI	Scientific probe to make a test of Einstein's Theory of Relativity.
Air Force	May	Scout	WTR	USAF scientific payload. Reimbursable.
Marisat-B	May	Delta	ETR	Second Comsat Corp. satellite to provide maritime satellite communications services. Reimbursable.
Navy Transit	June	Scout	WTR	Navy navigation satellite. Reimbursable.
Indonesia-A (Palapa)	July	Delta	ETR	Indonesian communications satellite. Reimbursable.
NATO IIIB	Aug.	Delta	ETR	Communications satellite in synchronous orbit to perform communications relay for NATO. Reimbursable.
Comstar-B	Aug.	Atlas-Centaur	ETR	Second domestic communications satellite for Comsat. Reimbursable.
ITOS-E2	Sept.	Delta	ETR	Operational meteorological satellite of the National Weather Service to provide daytime and nighttime cloud cover imagery. Reimbursable.
RCA-C	Oct.	Delta	ETR	Third domestic communications satellite for RCA. Reimbursable.
Marisat-C	Dec.	Delta	ETR	Third Comsat Corp. satellite to provide maritime satellite communications services. Reimbursable.
Intelsat-IVA-C	Dec.	Atlas-Centaur	ETR	Third of a series of improved Intelsat Consortium satellites. Reimbursable.

NASA Tech Briefs

The Technology Utilization Office, NASA Headquarters

(The following is a listing of published NASA Tech Briefs. Inquiries concerning them should be directed to the TU office of the originating NASA center.)

Innovator(s)	Title		
R. L. Johnson and M. A. Swikert, LeRC	Hip-Joint Simulator Accurately Duplicates Human Walking Pattern	B75-10148	LeRC
R. E. Walker and D. L. Kors, Aerojet Liquid Rocket Co.	Investigations of Multiple Jets in a Crossflow	B75-10149	LeRC
G. R. Sundberg, LeRC, and D. E. Baker Westinghouse Electric Corp.	Solid State Remote Power Controllers for 120 VDC Power Systems	B75-10150	LeRC
H. E. Sliney and T. P. Jacobson, LeRC	Graphite Fiber-Polymide Composite Rod End Bearings for High-Temperature High-Load Applications	B75-10151	LeRC
R. W. Miller, Atkins and Merrill, Inc.	RETSCP—A Computer Program for Analysis of Rocket Engine Thermal Strains with Cyclic Plasticity	B75-10186	LeRC
R. C. Hendricks, A. K. Baron and I. C. Peller	Computer Program for Calculating Thermodynamic and Transport Properties of Fluids	B75-10188	LeRC
R. D. Ingebo and C. T. Norgren, LeRC	Improved Air Atomizing Splash-Groove Fuel Injector Reduces Pollutant Emissions from Turbojet Engines	B75-10190	LeRC
J. F. Connors and R. A. Mauer, LeRC	Safety Management of a Complex R&D Ground Operating System	B75-10241	LeRC
Henry F. Veldman, Boeing Co.	Computer Program for the Attenuation of High Bypass Turbofan Engine Noise	B75-10242	LeRC
John L. Hess, McDonnell Douglas Corp.	Improved Axisymmetric Potential Flow Computer Program	B75-10243	LeRC
Philip A. Studer, GSFC	Three-Phase DC Motor Decoder	B75-10247	GSFC
Harry E. Peters, GSFC	Variable-Volume Atomic Storage Vessel for Hydrogen Masers	B75-10248	GSFC
Ronald M. Muller, GSFC	Position Sensing Materials Wound on a Reel	B75-10249	GSFC
Computer Library, GSFC	Optical Design Computer Program: LENS II	B75-10250	GSFC
Philip A. Studer, GSFC	Single Radial Magnetic Bearing: A Concept	B75-10251	GSFC
D. K. Edwards, J .E. Eninger, and B. D. Marcus of TRW Systems Group	Computer Integration of Hydrodynamics Equations for Heat Pipes	B75-10252	GSFC

NASA Documents to Library of Congress—Lawrence P. Hall (left), NASA's Chief of Planetary Quarantine Programs, presents 38 rolls of microfilm, representing some 2,300 documents, to Nathan R. Einhorn, Chief of the Exchange and Gift Division of the Library of Congress. The documents are on the subject of 15 years of NASA research and development related to the sterilization of spacecraft to prevent contamination of planets by terrestrial biota. The Library of Congress will make the data available to researchers. The presentation by Hall was one of his last duties before retiring from Government service after 34 years. Hall came to the PQ office at its inception more than a dozen years ago, and was its one and only chief. Previously he was with the U.S. Public Health Service.

Grace L. Picciolo and Emmett W. Chapelle, GSFC, and Michael J. Barza, Louis Weinstein, Stephanie A. Tuttle and Hiller Vellend of New England Medical Center	Rapid Method for Determination of Antimicrobial Susceptibilities Pattern of Urinary Bacteria	B75-10253	GSFC
J. Davenport, J. A. Foster, and W. R. Langley, KSC	Portable Headset Microphone Checker	B75-10254	KSC
John P. Wise and Walter E. Grimes, KSC	Start/Stop Switches for Testing Detonation Velocity of Explosives	B75-10255	KSC
John B. Peterson, Jr., LaRC and Allen W. Chen of National Research Council	Design Procedure for Low-Drag Subsonic Airfoils	B75-10256	LaRC
Donald J. Progar and Vernon L. Bell, LeRC, and Terry L. St. Clair of Virginia Polytechnic Institute & State University	Process for Preparing Polymide Adhesives	B75-10257	LaRC
Moses J. Long and Stephen C. Irick, LaRC	Reducing Flow Requirements of Fluid Actuators	B75-10258	LaRC
C. S. Chang, New Technology, Inc.	Two-Directional Active Damper	B75-10259	LaRC
Allan W. Love, Rockwell Intl. Corp.	Simple Temperature Sensor with Direct Readout	B75-10260	LaRC
Vernon L. Bell, LaRC and Terry L. St. Clair, Virginia Polytechnic Institute & State University	Diamine Curing Agents for Polyurethanes	B75-10261	LaRC
Peter C. von Thuna of Arthur D. Little, Inc.	Tuneable Diode Laser Spectrometer with Integral Grating	B75-10262	LaRC
E. W. Wojtaszek, Martin Marietta Corp.	Improved General Purpose Namelist Processor	B75-10263	LaRC
Donald E. Barthlome, LaRC	Braking Action of Wheeled Vehicles Is Controlled Automatically during Minimum-Distance Stops	B75-10264	LaRC
P. E. Geise, Jr., M. Petcher, and D. F. Cornwell of Sperry Rand Corp.	Real-Time Video Correlator	B75-10265	FSFC
L. B. Holdeman, MSFC	Increasing Terminal Strip Efficiency at Cryogenic Temperatures	B75-10266	MSFC
R. Hella, E. Locke and S. Ream, Avco Everett Research Laboratory	Industrial Laser Welding: An Evaluation	B75-10267	MSFC
J. F. Miller and S. H. Gelles of Battelle Memorial Institute	Single Crystals of Metal Solid Solutions: A Study	B75-10268	MSFC
W. M. Portnoy and H. Dirilten of Texas Technological University and C. E. Burton of Southwest Research Inst.	Electrocardiogram Signal Analyzer	B75-10269	JSC
J. Lester and D. A. Wendling, Beech Aircraft Corp.	Suspension System for Lightweight Cryogenic Tank	B75-10270	JSC
J. L. Youngblood, JSC and M. Raghavan, National Research Council	Influence of Heat Treatment on Mechanical Properties of 300M Steel	B75-10271	JSC
D. E. Kerr, Johns Hopkins Univ.	Ultraviolet Hydrogen-Discharge Lamp	B75-10272	JSC
W. M. Lear, TRW, Inc.	A Study of Accuracy in Selected Numerical Analysis Integration Techniques	B75-10273	JSC
J. A. Zill and K. D. Castle	Response of Tantalum Capacitors to Fast Transient Overvoltages	B75-10274	JSC
Robert T. Menzies, Caltech/JPL	Laser-Excited Fluorescence for Measuring Atmospheric Pollution	B75-10275	NapO

Noted Historian Addresses NASA Employees—Dr. Arthur M. Schlesinger, Jr. (left), Pulitzer Prize winning historian, spoke to more than 450 Langley Research Center employees recently on the subject, "A Bicentennial Look at America: Crisis of Confidence." Later he addressed an audience at nearby Hampton High School in the public lecture series "Our Future in the Cosmos," co-sponsored by NASA and the College of William and Mary. In this photo, Schlesinger is greeted by Donald P. Hearth, LaRC Director.

Paul O. Chelson, Caltech/JPL and Eric Y. Eckstein, VIP Engineering	Reliability Computation from Reliability Block Diagrams	B75-10276	NapO
Charles H. Lucas, Caltech/JPL	Highly Stable Analog-to-Digital Converter	B75-10277	NapO
Marvin Perlman, Caltech/JPL	Generation of Key in Cryptographic System for Secure Communications	B75-10278	NapO
Robert C. Clauss, Caltech/JPL	Reflected-Wave Maser	B75-10279	NapO
Alan Rembaum, Caltech/JPL	Improved Polyelectrolyte for Ion Exchange Fibers	B75-10280	NapO
Robert W. Berwin, Peter R. Dachel and Ervin R. Weibe, Caltech/JPL	Low-Noise K_u-Band Receiver Input System	B75-10281	NapO
Albert J. Bauman, Caltech/JPL	Removal of Ice and Marine Growth from Ship Surfaces: A Concept	B75-10282	NapO

Patents for Inventions from NASA Research

(The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel for the indicated installation.)

Inventor(s)	Title and NASA Docket	Patent No.	Installation
John L. Burch and James C. Billions, NASA/MSFC	Speed Calculator (MFS-22,638-1)	3,933,050	MSFC
Joseph H. Kerr, NASA/MSFC	Traffic Survey System (MFS-22,631-1)	3,930,735	MSFC
Ambrose W. Byrd, NASA/MSFC	Thermoelectric Power System (MFS-22,002-1)	3,931,522	MSFC
Madeline S. Toy, McDonnel Douglas Corp., Santa Monica, Calif.	Utilization of Oxygen Difluoride for Syntheses of Fluoropolymers (NPO-12,061-1)	3,931,132	NAPO
Siegfried O. Auer, Nat'l. Academy of Science, Wash. D.C.	Moving Particle Composition Analyzer (GSC-11,889-1)	3,931,516	GSFC
James F. McChesney, Jr., NASA/GSFC	High Voltage Distributor (GSC-11,849-1)	3,931,456	GSFC
Reginald J. Exton, NASA/LaRC	Stack Plume Visualization System (LAR-11,675-1)	3,931,462	LaRC
David B. Robelen, NASA/LaRC	Deploy/Release System (LAR-11,575-1)	3,930,628	LaRC
Salvatore J. Grisaffe, NASA/LeRC Stanley R. Levine, NASA/LeRC	Improved Coatings for Refractory (LEW-11,179-1)	3,931,447	LeRC

Star "Trekkies" Are Briefed on NASA Goals—L. to r., Jesco von Puttkamer of NASA's Office of Space Flight; James Doohan, "Scotty," the chief engineer of Star Ship *Enterprise* of the TV series "Star Trek"; Nichelle Nichols, "Lt. Uhura," *Enterprise* communications officer on "Star Trek"; and NASA Associate Administrator Herbert J. Rowe discuss science fiction and real space science at a recent session at NASA headquarters. The occasion was the four-day International Star Trek Convention, held in Washington, D.C., at which von Puttkamer—a "trekkie" himself—told the youthful audience of several thousand that NASA wants to meet "humanistic as well as scientific needs," and that NASA managers hope to include "a little of the dreams of young people in the space program." Von Puttkamer is a frequent speaker at "Star Trek" gatherings, at which he defines the NASA mission, shows slides of NASA activities, and participates in off-the-cuff discussions of space matters. He recently appeared (along with Leonard Nimoy, "Mr. Spock" on the TV series) before audiences of some 15,000 convention attendees in New York City.

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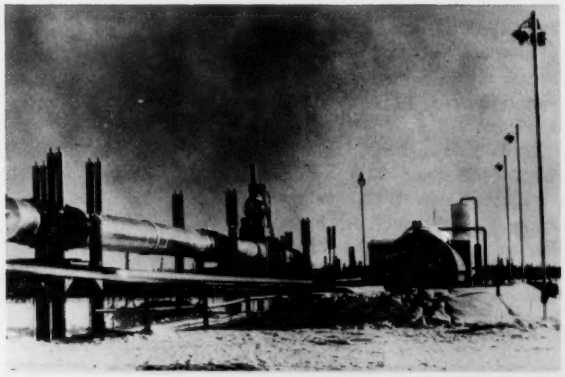
New System for Installing Pipelines in Cold Regions

Heat pipe technology developed initially for NASA's Skylab Orbital Workshop has helped greatly in providing an answer to environmental problems encountered in the laying of pipeline for Alyeska, the trans-Alaskan pipeline consortium. McDonnell-Douglas Corporation's Tulsa plant is manufacturing heat pipes that help prevent permafrost from thawing around supporting piles for elevated portions of the 1,287-kilometer (about 800-mile) trans-Alaska pipeline. The thermal-control devices being used are an offshoot product of NASA's Technology Utilization Program. The development program was under the direction of NASA's Industrial Applications Center at the University of New Mexico.

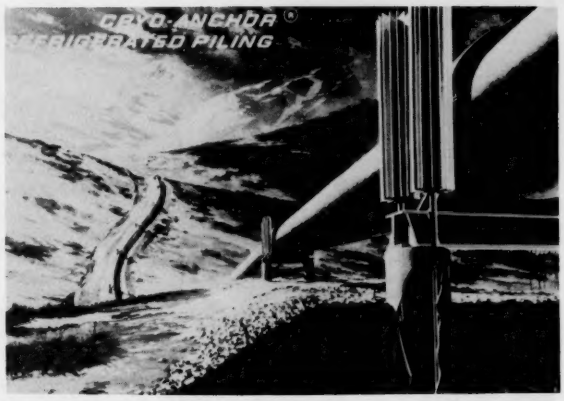
Extending beneath the Arctic tundra as deep as 1.8 meters (six feet), the pipes use a waterless ammonia process that needs no moving parts. When any heat is detected along the walls of a pipe, ammonia vaporizes and absorbs the heat. The vapor rises to the top of the system where it condenses and releases heat through a radiator, into the atmosphere. The condensed liquid then flows back down the walls. When another warm spot is sensed, the process is repeated.

The procedure helps freeze the soil for the full length of the pipe in winter and is able to maintain a solid mass of permafrost around the piles in summer. By keeping the frozen mass intact, soil shifting is reduced and line-settling is avoided. Without this thermal control, repeated freezing and thawing of the soil could cause stress to the crude-oil line to the point of rupture. In addition, without thermal protection, tundra erosion would undoubtedly result from the moisture that would rain down intermittently upon 628 kilometers (390 miles) of land spanned by elevated pipeline. McDonnell-Douglas is turning out more than 110,000 heat pipes, called Cryo-Anchor soil stabilizers.

NASA's Goddard Space Flight Center worked directly with Alyeska in the heat-pipe design, as did the NASA Industrial Applications Center at the University of Southern California.



McDonnell-Douglas Corporation's test facility in Alaska for testing heat pipe technology.



Heat pipes will stretch across 500 kilometers of Alaskan tundra, from the oil field at Prudhoe Bay to the port of Valdez.

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